## REMARKS

Claims 8-23 are pending in this application.

In view of the following remarks, reconsideration and allowance are respectfully requested.

## I. Rejections Under 35 U.S.C. §103

### A. Ono and Sakurada

The Office Action rejects claims 8-17 and 21-23 under 35 U.S.C. §103(a) over U.S. Patent Application Publication No. 2002/0017234 to Ono et al. ("Ono") in view of U.S. Patent Application Publication No. 2003/0116082 to Sakurada ("Sakurada"). Applicants respectfully traverse the rejection.

Claim 8 recites, "A method for producing a single crystal by pulling a single crystal from a raw material melt in a chamber in accordance with Czochralski method, comprising pulling a single crystal having a defect-free region which is outside an OSF region to occur in a ring shape in the radial direction and in which interstitial-type and vacancy-type defects do not exist by controlling a V/G value as indicated by a growth rate (V) and a temperature gradient (G) near a growth interface, wherein the pulling of the single crystal is performed with being controlled so that an average of cooling rate in passing through a temperature region of the melt point of the single crystal to 950 °C is in the range of 0.96 °C/min or more and so that an average of cooling rate in passing through a temperature region of 1150 °C to 1080 °C is in the range of 0.88 °C/min or more and so that an average of cooling rate in passing through a temperature region of 1050 °C to 950 °C is in the range of 0.71 °C/min or more." Applicants respectfully assert that Ono and Sakurada, individually or in combination, would not have rendered obvious each and every feature of claim 8.

According to the claimed invention, when the average cooling rates passing through the three claimed temperature regions are controlled, a range of V/G value to be within a N

region can be considerably enlarged, compared to the conventional method. Thus, production of a single crystal having a N region is relatively easy and the yield and productivity of the single crystal having a N region can be considerably improved. Specification, page 9, lines 4-20 and page 15, line 6 - page 16, line 5.

The Office Action asserts that Ono discloses the fabrication of single crystal silicon ingots from raw material via the Czochralski method, whereby the single crystal product is produced having a substantially defect-free region in the Denuded Zone, which is generally understood to be in existence outside the OSF region, where it is in a radial outwardly form given that the desired intention is to fabricate round single crystal wafers. See Office Action, page 3. However, Ono merely discloses a process of device manufacture wherein oxygen existing near the wafer surface is diffused to the outside by a high-temperature heat treatment. Thereby, a surface-layer region, where the device is to be formed, is formed from the Denuded Zone layer, which is free of crystal defects. Put differently, the portion of Ono relied upon by the Office Action is directed to a process of manufacturing wafers and, thus, unlike claim 8, it has no relation to controlling a V/G value or pulling a single crystal having a N region in the process of producing a single crystal ingot in accordance with the Czochralski method.

Additionally, the invention of Ono is directed to epitaxial wafers, and it is merely by epitaxial growth that a region free of crystal defects is formed on the surface. The region of Ono that is free from crystal defects has no relation to pulling a single crystal having a N region or controlling a V/G value and pulling a single crystal ingot. Therefore, Ono is directed to forming epitaxial wafers and not directed to controlling a V/G value while pulling a single crystal ingot and, thus, it would not have been obvious to one of ordinary skill in the art to have modified a process for forming an epitaxial wafer to provide the claimed method of pulling a single crystal having a N region or controlling a V/G value, as recited in claim 8.

The Office Action further asserts that Ono discloses a series of cooling rate steps that fall within the ranges as claimed. See Office Action, page 3. However, Ono merely discloses, "[t]he second single crystal is a silicon single crystal produced by the Czochralski method by selecting a cooling rate of not less than 7.3° C./min in the temperature range of 1200-1050° C. in the step of pulling up and a cooling rate of not more than 3.5° C./min in the temperature range of 1000-700° C. The method of manufacturing epitaxial wafers according to the present invention is characterized in that an epitaxial layer is grown on the surface of silicon wafers sliced from that single crystal." Ono, paragraph [0031]. Thus, Ono merely discloses pulling up during the first cooling step, wherein the temperature range is from 1200-1050°C and the cooling rate is not less than 7.3°C/min. Ono then discloses that a slow cooling of not more than 3.5°C/min takes place in the temperature range of 1000-700°C in order to form an oxide precipitate nuclei. See Ono, paragraph [0032].

Therefore, Ono merely describes cooling rates in the temperature range of 1200-1050°C and in the temperature range of 1000-700°C that are, respectively, not less than 7.3°C/min and not more than 3.5°C/min. Ono does not disclose a cooling rate in the temperature region from 1050-1000°C and, thus, Ono does not disclose a cooling rate for the entire temperature region of 1050°C to 950°C as claimed. Further, Ono does not disclose a cooling rate for the temperature region from the melt point of the single crystal to 950°C, as claimed. Therefore, Ono does not provide any reason or rationale for one of ordinary skill in the art to control pulling up of a single crystal so that an average of a cooling rate in passing through a temperature region of the melt point of the single crystal to 950°C is in the range of 0.96°C/min or more, as recited in claim 8, at least because Ono fails to disclose controlling the cooling rate in a temperature range from the melt point of the single crystal to 950°C and also because Ono does not provide any reason or rationale for one of ordinary skill in the art to have controlled the pulling of the single crystal in such a temperature range.

Similarly, regarding the temperature range of 1050°C to 950°C, as recited in claim 8, Ono does not disclose the entire range, but rather only discloses a range of 1000-950°C. Further, Ono does not disclose or provide any reason or rationale for one of ordinary skill in the art to have controlled pulling a single crystal so that an average of a cooling rate in passing through a temperature region of 1050°C to 950°C is in the range of 0.71°C/min or more, as recited in claim 8, at least because Ono does not disclose the entire temperature range of 1050°C to 950°C, and also because Ono does not disclose or provide any reason or rationale for one of ordinary skill in the art to have controlled pulling of the single crystal in this temperature range.

Alternatively, claim 8 recites controlling the average cooling rate passing through three temperature regions during the pulling of a single crystal. Therefore, claim 8 recites controlling the pulling up in all three temperature regions, which further enlarges a range of V/G that is within the defect free (N) region. However, Ono does not disclose or provide any reason or rationale for one of ordinary skill in the art to have expected that controlling pulling up of a single crystal within all three of the claimed temperature ranges can or should result in a larger range of V/G to be within a defect-free zone, with any reasonable expectation of success.

The Office Action, on page 4, acknowledges that Ono fails to disclose interstitial-type and vacancy-type defect non-existence via controlling the V/G value as indicated by growth rate (V) and temperature gradient (G) near a growth interface, or the specified diameter growth and whether a magnetic field is employed. Thus, the Office Action applies the disclosure of Sakurada to allegedly address the discrepancies of Ono.

However, Sakurada merely describes a method in which a crystal is grown in a defect-free region, which is a N region, on the outside of OSF in which a defect region, as detected by copper deposition, does not exist. However, Sakurada does not disclose or provide any

reason or rationale for one of ordinary skill in the art to have controlled the average cooling rate passing through the three temperature regions as claimed, or that pulling up of a single crystal within the three claimed temperature regions at the three claimed cooling rates would result in an enlarged V/G value that falls within a defect-free zone. Accordingly, Applicants respectfully assert that Sakurada does not address the above discrepancies of Ono as to claim 8. Therefore, Ono and Sakurada, individually or in combination, would not have rendered obvious each and every feature of claim 8.

Claim 8 would not have been rendered obvious by Ono and Sakurada, individually or in combination. Claims 9-17 and 21-23 variously depend from claim 8 and, thus, also would not have been rendered obvious by Ono and Sakurada, individually or in combination. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

**B. Ono, Sakurada and Iino**

The Office Action rejects claims 18-20 under 35 U.S.C. §103(a) over Ono in view of Sakurada and further in view of U.S. Patent No. 5,980,630 to Iino et al. ("Iino"). Applicants respectfully traverse the rejection.

For at least the reasons stated above, Ono and Sakurada would not have rendered obvious each and every feature of claim 8. The Office Action merely applies Iino as disclosing employing a magnetic field in the growth of single crystalline ingot materials. Therefore, Iino is not applied to address the above discrepancies of Ono and Sakurada. Thus, Ono, Sakurada and Iino, individually or in combination, would not have rendered obvious each and every feature of claim 8.

Claim 8 would not have been rendered obvious by Ono, Sakurada and Iino, individually or in combination. Claims 18-20 variously depend from claim 8 and, thus, also would not have been rendered obvious by Ono, Sakurada and Iino, individually or in

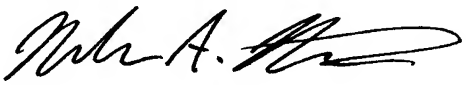
combination. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

## II. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of the application are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



William P. Berridge
Registration No. 30,024

Nicolas A. Brentlinger
Registration No. 62,211

WPB:NAB/kjl

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**OLIFF & BERRIDGE, PLC**
**P.O. Box 320850**
**Alexandria, Virginia 22320-4850**
**Telephone: (703) 836-6400**

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